World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:14, No:12, 2020

Hybrid Rocket Motor Performance Parameters: Theoretical and Experimental Evaluation

Authors : A. El-S. Makled, M. K. Al-Tamimi

Abstract : A mathematical model to predict the performance parameters (thrusts, chamber pressures, fuel mass flow rates, mixture ratios, and regression rates during firing time) of hybrid rocket motor (HRM) is evaluated. The internal ballistic (IB) hybrid combustion model assumes that the solid fuel surface regression rate is controlled only by heat transfer (convective and radiative) from flame zone to solid fuel burning surface. A laboratory HRM is designed, manufactured, and tested for low thrust profile space missions (10-15 N) and for validating the mathematical model (computer program). The polymer material and gaseous oxidizer which are selected for this experimental work are polymethyle-methacrylate (PMMA) and polyethylene (PE) as solid fuel grain and gaseous oxygen (GO₂) as oxidizer. The variation of various operational parameters with time is determined systematically and experimentally in firing of up to 20 seconds, and an average combustion efficiency of 95% of theory is achieved, which was the goal of these experiments. The comparison between recording fire data and predicting analytical parameters shows good agreement with the error that does not exceed 4.5% during all firing time. The current mathematical (computer) code can be used as a powerful tool for HRM analytical design parameters.

Keywords : hybrid combustion, internal ballistics, hybrid rocket motor, performance parameters
Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development
Conference Location : Chicago, United States
Conference Dates : December 12-13, 2020